# ASC ENGINEERING FACT SHEET

*... An Engineering Success Story*

# Escape Systems Modeling Capability

## SUMMARY

**Problem:**

- The performance of various aircraft escape systems and personnel bailout systems can be very difficult to quantify due to technical problems and the expense of testing.
- Complete reliance on computational modeling by contractors is very expensive and not very versatile for legacy systems.
- Escape systems are complex, dynamic systems that require experience to model usefully.

**Solution:**

- ASC/EN has developed a method to computationally assess the performance of escape systems and personnel bailout systems.
- The ability to develop in-house models evolved expertise to model many diverse escape systems including ACES-II ejection seats, jettisonable canopies, manual bailout, and an aircraft recovery system.

## DESCRIPTION

Since the late 1960's, ASC/EN's Crew Systems Branch (ASC/ENFC) has relied on computational modeling to assess the performance of escape systems including ejection seats, canopies/hatches and manual bailout systems. Since the beginning of the 1990's the Crew Systems Branch has developed an in-house modeling capability for these systems. Organic capability started with the transition of ACES-II escape system models to the branch from AFRL in 1985. The model was used and modified to support F-16, F-15, B-1, B-2, F-22, NASP, and the Life Support System Program Offices, for developments such as the Advanced Recovery Sequencer program as well as personal equipment integration issues in support of preparations for the Gulf War. In addition, this model supported many crash investigation boards as well as seat

performance inquiries from ACC.

Modification of an existing model led to the expertise to start writing our own models. The first effort started with a need to assess the performance of unusually heavy jettisoned canopies that presented a collision potential. It used simple, limited-degree-of-freedom models. Later the F-16 SPO wanted to know the potential value of continuing a canopy remover rocket program that was only reaching 75 percent of its projected impulse. This model integrates a complex, aerodynamic data set with the modeled mechanics of the canopy. The output indicated no substantial benefit would be obtained and the program was cancelled. This model was then slightly modified and used to support an NVS program from HSW/YA to determine when the helmet mounted NVS would be exposed to airflow. At the time, no other model existed to provide this data.

In response to a C-130J Gunship request to look at bailout potential from the front door, ASC/ENFC created a model to look at the contact potential with the many protrusions of this aircraft. Later, this model would be modified and used to evaluate manual bailout from the twin-tailed RG-8 surveillance aircraft and paratrooper airdrop from the C-17. The C-17 experienced paratrooper collisions when airdrops were made from both doors. ASC/ENFC models identified many of the important contributors to this effect. The unique understanding garnered from these models allowed ENFC to develop the data reduction methods and software used to eventually fix the paratrooper collision problem with a designed experiment. The software could evaluate individual tests for collision potential as well as run single tests, virtually comparing them to individual tests from the opposite door for separation analysis. This software made it possible to define flight conditions that allow safest airdrop from the C-17.

ASC/ENFC has authored a model for the U-2R to generate a requested performance envelope, which was previously unavailable to be included in the DASH-1. The model was also used in two U-2R crash investigations.

To support inquiries by AETC on the T-38, a T-38 model was written and used to compare performance to modern ejection seats. These results were briefed to AETC. AETC also looked into a recovery system for the T-3 trainer aircraft. When the aircraft contractor could not assess the performance of such a system, this office wrote a model that filled this void.

The escape system modeling capability and expertise of ASC/ENFC not only improves the safety of our aircrew but also saves the Air Force money.

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